SECOND BI-MONTHLY PROGRESS REPORT
UNIVERSITY OF ALASKA
ERTS PROJECT 110-12
December 12, 1972

A. TITLE OF INVESTIGATION:

Evaluation of feasibility of mapping seismically active faults in Alaska.

B. PRINCIPAL INVESTIGATOR/GSFC ID:

Larry Gedney GSFC ID: UN601

C. PROBLEMS IMPEDING INVESTIGATION:

None

D. PROGRESS REPORT:

1. Accomplishments during reporting period:

Since the last reporting period, a good deal of ERTS-1 imagery has been received, and analysis of the data is well underway. The following paragraphs list the images which have been initially selected for intensive study.

1029-20381: Detail of lineaments in the White Mountains northeast of Fairbanks. Shaw Creek Fault apparently offsets Tintina Trench and Yukon River left-laterally.

1029-20383: Shaw Creek Fault southeast of Fairbanks (this is a much more prominent feature than previously realized; it has only recently been recognized as a fault).

1033-21020: Denali Fault near Mt. McKinley. Also excellent examples of surging glaciers.

1063-20273: An excellent view of the intersection of the Denali and Totschunda Faults. The Totschunda Fault appears two-branched at this point.

1063-20280: Chugach Mountains. Numerous probable faults.

1066-20444: This scene contains a seismically active fault which has not been previously mapped. A magnitude 4.8 earthquake occurred here on October 1st of this year (see "signigicant results").

1066-20451: Castle Mountain Fault, northern Kenai Peninsula and Talkeetna Mountains.

1072-21180: An excellent view of bedding and structure in the southern Brooks Range. This scene is much superior to earlier images of the same area.

1081-20275: This frame is nearly identical with 1063-20273, except that, due to a lower sun angle, a small reverse fault which is not seen in earlier frames is clearly visible on the west flank of Mt. Sanford (see "significant results").

1103-20495: A view of the Yukon Flats, northern Tintina Trench, and at least one associated fault.

1103-20502: An excellent view of Fairbanks, the Chena lineament (flight line 19 of test site 314 flown by NASA aircraft) and the complex set of fractures and lineaments in the White Mountains to the north.

1103-20504: A magnificent view of the Denali Fault and associated structures in the Alaska Range.

1103-20513: Anchorage, the Castle Mountain Fault, and the steep escarpment of the Kenai Mountains.

1103-20520: While no faults are readily apparent in this scene, it does provide an overlook of the most seismically active area in the state (excluding the Aleutians) and Augustine Volcano in Cook Inlet.

1103-20531: Talkeetna Mountains and Susitna River basin. Faults are visible south of Mt. McKinley.

1105-21012: This scene shows a portion of the Tintina lineament, several lesser faults, and considerable structure in the southern Brooks Range.

1105-21015: This scene clearly shows the Minook Creek Fault (not named or generally recognized before an earthquake here in 1968), the Minto Fault, the Tintina Trench, and numerous unnamed faults and lineaments. A complex area.

1105-21021: Structure in the area northwest of Mt. McKinley.

In inspecting the ERTS-1 imagery, we have generally found it beneficial to produce our own positive prints from the 70mm negatives. Individual attention can be given to each print in this manner, and some of the difficulties experienced with the too-dense negatives can be overcome. Another common procedure has been to project the positive transparencies with a lantern slide projector so that group discussions can be held. No special techniques of treating the imagery have yet been attempted.

Much of the NASA aircraft data has been gone over. In some cases (notably on line 17 of test site 314), it has been possible to trace fault lines considerably past their mapped limits. Various geological phenomena of

peripheral interest have also been found (see "significant results").

2. Plans for next reporting period:

To date, this project has received imagery of 66 scenes, nearly all of which are provided with all four MSS spectral bands. Because of the sheer volume of the data, the primary emphasis has been placed on studying the better scenes in some detail, although all of them have been looked at, at least perfunctorily. During the next reporting period, we merely intend to proceed as we have been doing: selecting individual scenes for detailed study, producing prints and enlargements of areas of particular interest, making mosaics in areas where the object of interest may extend into adjoining frames, and mapping as we go. Although we do not anticipate utilizing any special enhancement techniques at this stage, it is probable that we will do some experimenting with reconstituting color scenes by the 3M color-key process.

E. SIGNIFICANT RESULTS:

See separate pages.

F. PUBLICATIONS:

None.

G. RECOMMENDATIONS:

Reduce density of negatives. Re-evaluate decision to discontinue coverage when sun angle drops below 10°. From our experience, those products made at very low sun angle are vastly superior for the purpose of determining surface detail, regardless of snow cover. Compare, for example, 1072-21180 with 1036-21175 or 1081-20275 with 1063-20273.

H. CHANGES IN STANDING ORDER FORMS:

Our standing order form was amended to include coverage to the end of November 1972, and to provide for earlier coverage in the spring. The original standing order form provided for coverage only until the end of October. The change was made because Alaska was experiencing beautiful clear weather as ERTS-1 passed over during the first week in November.

I. ERTS IMAGE DESCRIPTORS FORMS:

See attached sheets.

J. DATA REQUEST FORMS:

None.

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PRINCIPAL INVESTIGATOR: Larry Gedney

TITLE OF INVESTIGATION: Evaluation of feasibility of mapping seismically active faults in Alaska.

DISCIPLINE: Mineral Resources, Geological Structure and Landform Surveys.

SUBDISCIPLINE: Earthquake Zones Investigations.

SUMMARY OF SIGNIFICANT RESULTS:

A previously unmapped seismically active fault has been identified in south-central Alaska on the basis of ERTS-1 MSS imagery (image ID no. E-1066-20444, bands 4, 5, 6, 7). Surface expression of the fault is a lineal depression, along which streams flow and sag ponds form. It can be traced for at least 120 km, with end points at approximately 62°26'N, 149°23'W, and 63°14'N, 147°44'W. On October 1, 1972, an earthquake of magnitude 4.8 occurred on this fault near its southern end. The event was felt throughout the Susitna Valley. Inspection of seismicity records dating back to 1967 reveals that earthquakes in this area have tended to cluster along the fault, particularly near the two end points. Although it would appear that the Susitna River has been offset left-laterally, the fault plane solution obtained for the event of October 1 indicates right-lateral displacement. This suggests that the feature may be a strand of the Denali Fault, which it would intersect at an angle of about 45° if projected northward. What is thought to be another unmapped fault is found on the northwest flank of Mt. Sanford (roughly 62°15'N, 144°15'W). While this area is not particularly seismically active, this minor fault is of interest from two standpoints. First, it is evident from the lighting and from stream incision that it is a reverse fault. That is, the mountain has dropped with respect to the valley. Secondly, although the area has been imaged several times (e.g., MSS ID nos. E-1010-20331 on August 2 and E-1063-20273 on September 24), the only frame to date to show this feature is E-1081-20275, which was made on October 12. Since the sun angles on the three dates were, respectively, 43°, 25°, and 18°, it would appear that certain features may appear only under very low sun angles.

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SUBDISCIPLINE: Earthquake Zones Investigations.

SUMMARY OF SIGNIFICANT RESULTS:

A NASA aircraft (NP3A) was used to obtain data along a number of known and suspected fault lines in the Alaskan interior during the summer of 1972. Seismicity was the basis on which the suspected faults were picked. One of the suspected faults extended from the town of Nenana, past Fairbanks, and to the headwaters of the Chena River to the northeast. We herein refer to this feature as the Chena lineament. In 1967 a series of earthquakes (largest of magnitude 6.0) occurred on this lineament very close to Fairbanks, and since that time, aftershock activity has progressed in both directions from the epicenter along the lineament. This line was flown at 20,000 feet to obtain conventional and infrared photography, and thermal infrared scanning imagery, and it was flown at 10,000 feet to obtain side-looking airborne radar imagery. While the SLAR and conventional photography failed to reveal conclusive evidence of faulting, the IR scanner produced some interesting and unexpected results (mission 209, roll 48, site 314, frame 134). Just south of Fairbanks, on the Chena lineament in the aftershock zone of the 1967 earthquakes, there are what appear to be a series of steeply dipping folds. The odd things about these features are that they occur in an area which is normally regarded as being overlain by thick flood plain deposits, and that they have no apparent surface expression. Their appearance virtually rules out the possibility that they are old river meanders. The fold axes trend generally along the line of the Chena lineament, with an amplitude of about 7 km and a period of about 3 km. They do not have the appearance of being drag folds associated with a fault at the postulated azimuth, although this possibility cannot be ruled out. If they are indeed an expression of the underlying structure, the alluvium in this part of the Tanana Valley must be much thinner than has been thought. The fact that bedrock is found only five kilometers from the folds, however (at Clear Creek Buttes), suggests that this may be the case. No explanation is offered as to why thermal IR should show features of this sort.

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DISCIPLINE: Mineral Resources, Geological Structure and Landform Surveys

SUBDISCIPLINE: Earthquake Zones Investigations

SUMMARY OF SIGNIFICANT RESULTS:

A large scale, seismically active fracture system has been identified in central Alaska on the basis of ERTS-1 imagery (Image ID nos. E-1105-21015 and E-1105-21021, bands 4, 5, 6, 7). The system consists of two sets of fractures which intersect at an angle of about 55°. One set strikes at an azimuth of about 15°, and the other at about 320°. The dominant feature of the system is the Minook Creek fault, on which an earthquake of magnitude 6.5 occurred on October 29, 1968 at 65.4°N, 150.0°W. Fractures which parallel the Minook Creek fault are found in the local mountain complex, in the Ray Mountains to the northwest, and in the Kuskokwim Mountains to the southwest. The conjugate set of fractures (that is, the set striking at 320°) is most readily apparent in the Ray Mountains, although it is also visible in the mountains around Minook Creek. A possible related feature is a 60 km long lineament near the Toklat River north of Mt. McKinley. These areas are all moderately seismically active. Focal mechanism studies of the 1968 earthquake revealed that left-lateral displacement had occurred on the Minook Creek fault due to compressive stress at an azimuth of about 330°. A similarly oriented direction of compressive stress could be responsible for the entire fracture system. Image E-1105-21015 also contains a number of other faults, both mapped and unmapped. One such unmapped feature extends eastward from the vicinity of Minook Creek (roughly 65°38'N, 149°51'W), into Victoria Creek, and on for at least 150 km where it loses its identity in the Tintina Trench complex (Image ID nos. E-1103-20495 and E-1105-21012).

# ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D _____
N _____
ID _____

DATE 12 Dec 72

PRINCIPAL INVESTIGATOR Larry Gedney

GSFC UN 601

ORGANIZATION Geophysical Institute, University of Alaska

| PRODUCT ID (INCLUDE BAND AND PRODUCT) | FREQUENTLY USED DESCRIPTORS* Fault | Mountain | Glacier | DESCRIPTORS |
|---|---|---|---|---|
| 102920381M | x | x | | |
| 102920383M | x | x | | |
| 103321020M | x | x | x | |
| 106320273M | x | x | x | volcano |
| 106320280M | x | x | x | volcano |
| 106620444M | x | x | | |
| 106620451M | x | x | x | fiord |
| 107221180M | | x | | bed |
| 108120275M | x | x | x | |
| 110320495M | x | x | | river, floodplain |
| 110320502M | x | x | | city, river |
| 110320504M | x | x | x | |
| 110320513M | x | x | | city |
| 110320520M | | x | x | fiord, volcano |
| 110320521M | x | x | x | |
| 110521012M | x | x | | |

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO ERTS USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

GSFC 37-2 (7/72)

# ERTS IMAGE DESCRIPTOR FORM

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NDPF USE ONLY
D
N
ID

DATE 12 Dec 1972

PRINCIPAL INVESTIGATOR Larry Gedney

GSFC UN 601

ORGANIZATION Geophysical Institute, Univeristy of Alaska

| PRODUCT ID (INCLUDE BAND AND PRODUCT) | FREQUENTLY USED DESCRIPTORS* | | | DESCRIPTORS |
|---|---|---|---|---|
| | Fault | Mountain | Glacier | |
| 110521015M | x | x | | |
| 110521021M | | x | | bed |

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